



PUTTING RESEARCH TO WORK

BRIEF

Project Manager



"This research applied some very innovative techniques. It gives us a sense of how to evaluate ramp metering on a system-wide level."

—John Corbin

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Ramp Meters Work Well in Milwaukee, and Can Work Even Better

The Wisconsin Department of Transportation has been installing ramp meters in southwest Wisconsin since 1969. These stop-and-go traffic signals on freeway entrance ramps aim to reduce congestion by controlling the flow of traffic onto the mainline freeway. A ramp meter's presence has traffic implications upstream and downstream on the freeway, and on nearby arterials.

What's the Problem?

Unwarranted ramp meters cause delays on the ramp without providing equivalent travel time savings on the mainline, and poor meter timing algorithms diminish the benefits of a metering system. Sophisticated modeling of ramp meters and their effects on mainline traffic, arterial traffic, travel time, travel speed and collisions has not been undertaken in Wisconsin. Hence, the effectiveness of the state's ramp metering system has been unclear.

Research Objectives

This study's goal was to determine the benefits of ramp meters in the Milwaukee freeway system, including collision and congestion reduction. Researchers also sought to develop a framework for evaluating ramp meter effectiveness over an entire system, including both mainlines and arterials.

Methodology

Research teams studied a 15-mile stretch of the US 45 corridor—the freeway and two parallel arterials—in Milwaukee County, before and after ramp meters were installed on seven of 14 southbound on-ramps in March 2000. Researchers split the work into two studies. A team from the University of Wisconsin-Milwaukee studied traffic diversion and simulation in Part 1, while a Marquette University team researched travel times, travel speeds and collisions in Part 2.

Researchers collected comprehensive traffic data on US 45. Their tasks included:

- Recording travel times during morning and afternoon peak travel periods, before meter deployment and after.
- Using electronic detectors and road tubes to obtain traffic counts on the mainline, entrance and exit ramps, and arterials.
- Using video logs of license plates to determine the length of trips on the freeway.
- Counting vehicles in the queue at metered on-ramps during peak periods.
- Reviewing collision records from the six months before and six months after ramp meter deployment.

In addition, researchers analyzed a UW-Madison survey of Wisconsin drivers that included questions on drivers' route choices in reaction to ramp meter deployment. They also tested three traffic simulation software packages—Dynasmart-P, QRS II and Paramics—for use in modeling ramp meter operations at a system level.

Results

Ramp metering has been effective on the US 45 corridor, resulting in increased mainline speeds and reduced crashes. Overall, vehicle hours of travel decreased by 2% in the years following meter installation. Mainline travel time decreased by 5%, but ramp delay lowered this benefit. Unnecessarily restrictive metering algorithms triggered ramp delay in the morning peak hours.

Drivers react to delays at metered ramps. Where traffic volumes were heaviest or ramp queues longest, a significant number of drivers diverted their travel away from the freeway or from a specific ramp. If

Investigators



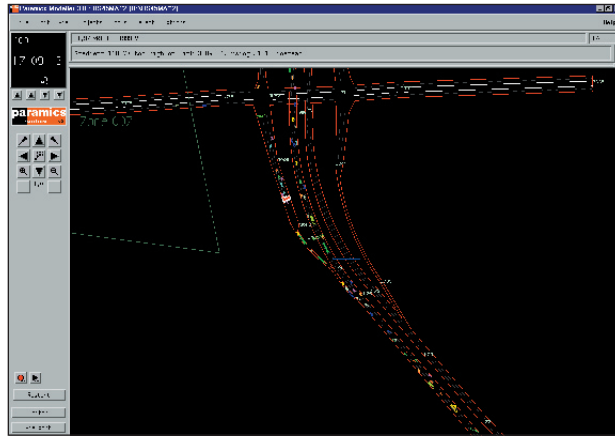
“The deployment of ramp meters in Milwaukee was beneficial, both in terms of travel time savings and in terms of crash reduction.”

—Alan Horowitz
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“Ramp metering was installed well ahead of when it would be a critical need—this allows time for fine-tuning.”

—Alex Drakopoulos
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Investigators used software, like the Paramics simulation shown above, to model traffic flow, traffic speed and delays. The simulations closely matched real traffic behavior (Fig. 4-7, page 96 of the Part 1 final report).

a metered ramp were overflowing with waiting vehicles, 82% of surveyed drivers said they would take an alternate route. Following meter deployment, drivers were less likely to use the freeway for very short trips, which resulted in less entering and exiting for a given level of mainline traffic.

Although the increase in volume after ramp meter deployment was minimal, speeds in the most congested south portion of the corridor increased by as much as 13% during the afternoon peak period, shortening travel time considerably. Corridor average speed increased by 4% during the afternoon peak.

The crash rate along the corridor fell 13% after meter deployment, which coincided with other road improvements—geometric improvements to ramp merging areas and mainline pavement resurfacing. Collisions during ramp metering hours were reduced from 298 to 260 per 100 million vehicle miles traveled.

The Paramics software successfully generated simulations of traffic behavior on US 45, with and without ramp metering, that closely matched real mainline speeds and ramp behavior. The simulations showed better traffic flow after meters were added.

Benefits

The data collected in this research will improve WisDOT’s already effective ramp meter placement and coordination. More precise meter deployment maximizes benefits to drivers, including reduced travel times and collisions.

Implementation and Further Research

Researchers recommend that WisDOT fine-tune the US 45 ramp metering parameters for morning peak periods to reduce ramp delays, which would reduce overall corridor delays. It may also be possible to reduce afternoon delays on some ramps without negatively impacting mainline travel times.

In addition, researchers suggest initiating a thorough review of the ramp meter timing algorithms currently used in Milwaukee, and considering alternate algorithms that could coordinate the timing of adjacent ramp meters.

Researchers also recommend that the Paramics models used in this study be used to analyze the effects of freeway operations policies that are not location-specific. The models should be refined to accommodate diversions to alternate routes and to account for the impact of upstream traffic signals.

This brief summarizes Project 0092-45-17, “Evaluation of Ramp Meter Effectiveness for Wisconsin Freeways, A Milwaukee Case Study,” produced through the Wisconsin Department of Transportation Research, Development & Technology Transfer Program, 4802 Sheboygan Ave., Madison, WI 53707.

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